

they were in some sort original. You mention as a kind of palliative that, although my priority is not distinctly admitted, my name is mentioned in a prominent manner.

Personally I consider this a very small affair. Long experience of having my name mentioned in a similar manner, or mixed up with the names of others, or altogether omitted in connection with certain coal-dust matters in which I have undeniable priority, has hardened me; and I confess that this part of your letter gave me no concern. But although I could afford to pass it over in this way as far as I am myself concerned, I cannot adopt the same course when the interests of some of the members of the Royal Commission on Accidents in Mines are also at stake.

I must therefore ask you to give me a token of your good faith by restraining your friends from publishing anything further until the English Royal Commissioners shall have seen fit to make known the results obtained here. At the same time also I would suggest it as a simple matter of duty on your part to take immediate steps to let it be known to those before whom your friends' communications have appeared that the credit, if any, of the original investigations in this case rests with Sir Frederick Abel and Mr. W. Thomas Lewis quite as much as with me.

Believe me yours very faithfully,

W. GALLOWAY

Herr Bergrath Kreischer, Professor der Bergbaukunde,
Freiberg, Sachsen

The Resting Position of Oysters

IN books on Conchology, such as Woodward's "Manual of the Mollusca" and Jeffrey's "British Conchology," it is stated that the oyster rests in the natural state on its left valve, which is the larger and more convex. In this respect it is pointed out the oyster differs from the animals belonging to the genera Pecten and Anomia, which rest on the right valve, the Anomias being firmly attached by muscle with the flat right valve applied closely to the surface of attachment. In his lecture on oysters at the Royal Institution, which was published in Nos. 1 and 2 of the *English Illustrated Magazine*, Prof. Huxley also states that oysters rest on the left or convex valve, the flat right valve acting as a kind of operculum. Examination of oysters from the Firth of Forth has convinced me that this statement is erroneous. I do not know on what evidence the current belief of conchologists is founded. The evidence which appears to me conclusive is that the right flat valve is always quite clean, while the convex valve is covered with worm tubes, *Styela grossularia*, and Hydroids. The latter are in this connection the most important; it would be impossible for specimens of Sertularia and Thuiaria 4 or 5 inches long to grow, as I have found them on almost every oyster, in the central part of the left valve, if that valve were the lower in position. On examining Pectens I found that they resembled the oyster in the contrast between the surfaces of the two valves, the upper convex one being covered with Balanus and other fixed animals, the lower being almost clean. It is generally stated that the Pecten lies on its right valve; if this statement rests on the evidence afforded by the condition of the surface of the valves the same criterion applied to the oyster leads to the same conclusion, that the right valve is the lower. I have never seen a young oyster in the attached condition: Huxley states that it is the left valve which is fixed; in papers on the embryology of the oyster I have not yet been able to find any definite information on the point. Whether it is the right or left valve that becomes attached when the larva assumes the sessile condition I cannot therefore say of my own knowledge, but with regard to the adult oyster it seems to me certain that the current belief is caused by the repetition of an error. My attention was first called to this point by my assistant, Mr. John Walker, who tells me that the opinion of the fishermen at Newhaven is divided on the point, some saying that the convex valve, others that the flat valve, is the lower.

J. T. CUNNINGHAM

Scottish Marine Station, Granton, October 14

Two Generalisations

Two generalisations seem to have been staring us in the face for some time, and yet I have seen no one give them a look of recognition; they may be phantasms, but they seem solid enough:—

(1) That the number of elements is infinite; the most readily-

formed types of ethereal vortices being the commonest, but our knowledge of them being only limited by the scarceness of the more complex forms, and not by any limit to the infinite varieties of complexity that may exist. Their relative commonness being analogous to the relative sizes of the bodies of the solar system; a few large, and always recognisable, and a greater number of examples as we descend in size to mere meteors. We already see that there are far more rare elements known than common ones.

(2) That the reduction of an electric current to heat in an imperfect conductor is solely due to the independent heat-motions of the molecules, which check and divert more and more of the current as their motions are larger; if there were no pre-existing heat-motions there would be nothing to resist a complete transmission of the current motion, and hence there would be no limit to conduction at the zero of temperature except the cohesion of the material.

Bromley, Kent

W. M. FLINDERS PETRIE

Meteors

ON the morning of October 13, at 2h. 26m., I saw a fine meteor giving a bright flash at the end point and leaving a streak for about 12 seconds. It shot from the Lynx towards the pointers in Ursa Major, and while carefully fixing its direction relatively to the stars near, another conspicuous meteor, about as bright as Jupiter, crossed the lingering streak in a path but slightly inclined to it and of nearly similar length. I have never before observed two large meteors almost simultaneous and with paths so nearly identical.

I subjoin the observed paths of these meteors, also of five other bolides recently noted here during the progress of my habitual watches for shooting stars:—

1885	G.M.T.		Mag.	Path		Length	Radiant
	h.	m.		From	To		
Sept. 9	15	48	2	149 + 82	152 + 64	18	335 + 71
" 15	15	11	2	37 + 6½	26½ + 7	10½	70 + 4
Oct. 7	10	51	2	51½ + 22	71½ + 24	18	31 + 18
" 8	15	9	2	155 + 53	162½ + 46½	8	42 + 55
" 12	14	26	9	119 + 51	151 + 60½	20	88 + 18
" 12	14	26	2	119½ + 50	143 + 60½	16½	103 + 33
" 16	16	35	2	213 + 47½	226 + 41	11	143 + 49

The radiant points are derived in each case by combination with many other meteors registered on about the same nights. I have seen 357 meteors since early in September, and those selected in the above table comprise all the brighter specimens estimated to equal Jupiter.

W. F. DENNING

Bristol, October 17

Statigrams

THE increasing use of graphic representations of statistics by means of lines, areas, &c., seems to render it convenient to have some word which would specially designate diagrams exhibiting the progress and tendencies of the numerous tables of figures which do not pretend to strict scientific accuracy. The word *diagram* is used in most elastic senses and by all sorts and conditions of men.

May I suggest the word *statigraph* as a definite and convenient one for adoption? This might be sometimes shortened to *graph*; whereas *statigram*, if preferred, would not admit of this abbreviation. Most, if not all, graphic results of statisticians, economists, anthropologists, &c., might thus be termed *graphs*, whilst mathematicians and the experimental men of science would be left with the use of their own words, such as *curves*, *indicator diagrams*, &c. Each class would possess its own degree and limits of accuracy: mathematical precision and the doctrine of energy would apply to the latter, but *graphs* would be understood to involve human elements with intricate factors whose recognition or relationships the statistics are intended to elucidate and compare rather than to define and measure.

12, Merton St., Oxford

J. F. HEYES

THE GEOLOGICAL SURVEY OF BELGIUM

PROBABLY no country of Europe has had its geology more attentively studied and mapped than Belgium. From the early labours of the veteran and pioneer

D'Omalius down to those of Dumont and his contemporaries, the structure of this country has engaged the attention of many able observers, and in its broad features is now well known. The map of Dumont, on the scale of 1-160,000, is one of the most excellent geological representations of any part of the European continent. But a good many years have passed away since its publication, and though it remains essentially accurate, it is now capable of improvement as regards details. Accordingly, after many discussions of the subject, a Commission was appointed to undertake a more detailed and exhaustive geological investigation of the country. This Commission consists of five members of European reputation, viz., M. Brialmont, Inspector-General of Engineers, one of the most distinguished engineer officers in Europe; M. Maus, Honorary Director-General of Bridges, Roads, and Mines, who made the preliminary plans for the piercing of the Mont Cenis Tunnel; M. Stas, the well-known chemist; M. Liagre, Perpetual Secretary of the Royal Academy of Belgium, who measured the geodetic baseline of Belgium; and M. Houzeau, Director of the Royal Observatory, whose writings on geological geography are widely appreciated. These able and thoroughly representative men of science were constituted as a Board of Control by which the operations of the Survey were to be governed, the practical carrying out of the work being placed in the hands of M. Dupont, Director of the Royal Museum of Brussels—a geologist of established reputation.

The work was begun in 1878 with the topographical map of the Engineer Department on the scale of 1-20,000th, or, roughly, about 3 inches to the British statute mile. It was estimated that the survey of the whole of Belgium on this scale would be completed in seventeen years from that date. This detailed map is divided into 430, or, excluding the frontier sheets, 369 sheets. Each of these is oblong in form, comprising an area of 10 X 8 kilometres, or 8000 hectares, or nearly 20,000 English acres. To produce upon this larger scale a map which should be only an enlargement and rectification of that of Dumont was very far from the object of the Commission. It was determined to adopt a monographic method of surveying. Each important geological system or group of formations has been entrusted to one or more specialists, who have given particular attention to its investigation, and who have been charged with the duty of tracing the same system or group completely across the country. Each geologist is furnished with two assistants who detach rock-specimens, collect fossils, make borings, and in other ways save the time and labour of the officer under whom they serve. Every actual outcrop of rock is marked on the map, and where the rock is fossiliferous the fossils are noted and the various palæontological subdivisions of the strata are traced, the collector being afterwards sent back where more ample collections are thought necessary.

It was from the first determined that the detailed geological map should be not merely a scientific undertaking, but a work of as much practical utility as possible. Special attention was accordingly given to the soils and subsoils, and care was taken to express upon the map the variations in the agricultural character of the ground. For greater exactness in this respect a system of boring was adopted. A stout auger was constructed which could be thrust a yard or so into the ground and bring up samples of the soil and subsoil. This instrument is made use of at intervals of 100 metres along the lines of traverse, so that the variations in the superficial layers can be accurately noted.

To secure harmony in the work, each officer entrusted with the survey of a particular series of strata from time to time confers with his colleagues who are engaged on contiguous bands, and thus the general geological structure of the country is worked out on a uniform plan.

Up to the present time thirteen sheets have been printed off, and many more are in various stages of

engraving and preparation. It is believed that one-third of the entire work of the survey has been completed. The ordinary topographical maps of the *État-major* are printed from zinc plates, and with their crowded contour-lines and rather blurred printing are but ill adapted for the insertion of further geological details and the reception of colour. The Commission of the Geological Map accordingly decided to engrave this map on copper, adding new roads and other features, but leaving out all non-essential topographical details. By this means an admirably clear base has been secured for the delineation of the geological structure, while at the same time copper-plate engraving has been introduced as a new industry into Belgium. Comparing the ordinary sheets with their geological equivalents we are struck with the great beauty and clearness of the latter. Even for every day topographical use they are immeasurably superior.

One of the great problems of geological cartography is how best to portray at once the superficial accumulations and the solid rocks that lie underneath these. In this country it has been found practicable on the detailed six-inch maps of the Geological Survey to represent the surface-deposits by various kinds of stippling on the copper plates, the alluvia and the solid rocks being expressed by tints of colour. On the one-inch maps, however, which show the surface features by shading, this method cannot be employed. It has accordingly been necessary to issue two versions of each sheet of the one-inch map—one showing the solid rocks, the other representing the distribution of the various drifts and other detrital accumulations. These maps are coloured by hand, and are often of great beauty, but of course are somewhat expensive, more especially as two editions are needed to complete the representation of each district. M. Dupont deserves the admiration of geologists for having solved this difficult problem in an altogether novel way, and for having produced a series of maps which will probably inaugurate a new departure in geological cartography. His principle is to represent all the geological formations of a district, ancient as well as modern, upon the same sheet. As the superficial accumulations extend across much the largest area of ground, they are shown by various broad washes of colour over the tracts which they respectively cover. These colours, though they necessarily spread over most of each sheet, are kept so subdued in tone that they do not interfere with the easy legibility of the stronger tints employed to denote the underlying solid rocks. Every actual outcrop of these rocks is marked by a patch of the colour chosen for the particular formation. We thus note at a glance the localities where the rocks of that formation can be seen at the surface. At these outcrops, signs are inserted to mark the dip, and any lithological or palæontological subdivisions which have been noticed, and regarding which a detailed legend on the sides and bottom of the map gives ample explanation. So far the map is merely a transcript of what is observed in nature. But it is of course necessary to express the limits of the several rock-groups. And it is here that M. Dumont's ingenuity is most remarkable. He shows these limits by dotted lines, the dots varying in strength according to the importance of the limit which they define, and by strips of colour. Each stage has its margin defined by a shaded strip of its characteristic colour where the actual boundary is concealed, while where the junction of two stages or sub-stages is actually seen on the ground, the colours are not shaded, but of the full strength. The eye can thus easily follow the windings of such sub-division across the map, and can at a glance mark where the actual exposures are to be observed on the ground.

As the maps are chromo-lithographed it is quite simple to secure harmony of tone and great clearness and accuracy. We at once perceive what is actual observation and what is inference. One is put in possession of

the data on which the geological boundaries have been traced, and can thus judge where and how far these are conjectural. We are not aware of any other published maps where this confession has been so frankly made.

The pale yellows and greys adopted for the superficial deposits cover so much of each sheet as to show at once how large a part of the ground is occupied by them. The detrital material is traced up to its source upon the tablelands, and being of poor agricultural value its colour on the map shows where farming operations are least likely to be successful. Where observations by boring or otherwise have been made on the nature of the soil and subsoil these are marked on the spot by the requisite sign, and as the borings are numerous these indications abound all over the map.

During the progress of the work improvements have been made in the methods of surveying and also in the modes of expressing geological details on the maps. In the Brussels area, for example, besides the ordinary borings into the soil and subsoil, deeper borings have been made to ascertain the nature and succession of the strata underlying the uppermost deposits. Messrs. Rutot and Van den Broeck, two of the staff, have invented an ingenious instrument with which they can ascertain the nature of the formations down to a depth of even 10 metres. By its means they have pierced below the subsoil in all directions, and have accurately traced out the areas of the younger deposits around Brussels. The results obtained by them at each boring are clearly engraved on the map; so that at numerous points all over the district the farmer, the water-engineer, the railway-contractor, the quarryman, and others can learn precisely through what layers they must pass in any cutting or excavation beneath the surface. By another ingenious device, the section of each artesian well at Brussels is represented on the map beside the position of the well, and so clearly that the succession of rocks bored through may be taken in by the eye at once.

Each sheet of this detailed survey is so crowded with information that to those who have been accustomed only to the ordinary style of geological map-making it may at first seem a little confused. But if any one will take the least trouble he will soon find that the confusion is only in appearance. No maps have yet been published in any country giving so large an amount of accurate information with such clearness and precision, and where the actual facts are kept so clearly apart from inference. These sheets are not wall-maps to be looked at from a distance, but detailed maps to be closely studied in the hand. And they will well repay an attentive study. There is probably no national Geological Survey in any part of the world which may not find in them some useful hint or suggestion for its own improvement.

On completion of the detailed survey it is part of the original plan to prepare a smaller or wall-map like that of Dumont. But such a map is hardly needed; at least its preparation can well stand over until the whole country has been surveyed in detail by the methods so well conceived by M. Dupont. But besides the maps, the work of the Belgian Survey has included the preparation of ample explanations illustrative of the maps. Each sheet is intended to be accompanied with an "Explication" giving the detailed structure of the ground, descriptions of the rocks, natural sections, lists of fossils, and all the information required as supplementary to the geological maps. A number of these memoirs have already been printed. Each of them contains fundamentally three sections running N. and S. across the formations, which in Belgium have a general E. and W. strike. These sections are described in detail, and full local references are given. The books are well printed, and the coloured plates of sections are excellent, while a novel attraction is given by the insertion into the text of coloured engraved sections of special localities.

None of the maps or explanations, though they have been ready for some time, have yet been published. They are to be seen, however, in some of the public libraries and museums in Europe. Belgium has every reason to be proud of them, and we trust that the delay in their publication will speedily be followed by the issue of the whole series now ready and by the completion of those in progress. It is impossible to over-estimate the practical utility of such a detailed survey in a country like Belgium. No time should be lost in pushing on and bringing to a conclusion a work which has been so admirably begun.

ARCH. GEIKIE

THE THIRD INTERNATIONAL GEOLOGICAL CONGRESS

THE third International Congress of Geologists, postponed last year on account of the spread of cholera in southern Europe, has just been held at Berlin. Each successive gathering has far surpassed its predecessors in numbers and in the representative character of its members, the numbers attending the meeting at Berlin being no fewer than 255. Of these of course the large majority were Germans, who mustered in all 163. Italy, however, furnished 18 representatives; Austria, 16; Great Britain, 11; France, 10; United States, 9; Belgium and Russia, 6 each; Sweden and Switzerland, 3 each; Norway and Holland, 2 each; Spain, 1; Brazil, 1; India, 1; Japan, 1; Portugal, 1; Roumania, 1. The meetings were held in the buildings of the Reichsrath, or Parliament, the large room set apart for the deliberations of the Congress being that of the Lower House of Representatives, and no little interest was taken by the foreign geologists in the names of the Members of Parliament inscribed on the backs of the seats. The door also was pointed out from which the great Chancellor emerges to launch his philippics against the contumacious opposition. But the *genius loci* inspired no flights of eloquence nor much disputatiousness among the geologists. The use of French as the language of discussion was no doubt one effective cause of silence on the part of many members who would otherwise only too readily have made themselves heard. Under such circumstances the Latin races have of course a considerable advantage over the Teutonic. One of the Berlin papers gave articulate expression to the complaint that in an audience nearly two-thirds of which were Germans, French should have been chosen, and great was the delight expressed by the German element in the Congress, when the Minister of Public Instruction, who officially welcomed the assembly, gave his eloquent and appropriate address in German. But by common consent, and with much good humour, though often with a disregard for the claims of grammar, idiom, and pronunciation that must have been infinitely ludicrous to the French-speaking members, the international official language was used throughout the proceedings.

The ostensible work of the Congress, which lasted nearly a week, may be divided into five parts. Of these the first in order of treatment and also of importance was the report of the Commission entrusted at the previous (Bologna) meeting with the preparation of a geological map of Europe. During the four years that have elapsed since the Congress determined to undertake this work, satisfactory progress with it has been made. The topographical outlines of the map have been completed and engraved, and the Commission were able to show upon the wall a mounted copy of the outline map. The materials necessary for filling in the geology have already been supplied for a large part of Europe, and it is expected that in the course of next year the work will be so far advanced that proofs in colour of many of the sheets of the map will be ready. There can be no doubt that the preparation of this great map is the most important and